

# OCULAR ALKALI BURN ASSOCIATED WITH AUTOMOBILE AIR-BAG ACTIVATION

Janette E. White,\* MD, FRCSC; Kevin McClafferty,† BSc; Robert B. Orton,\* MD, FRCSC;  
Alexander C. Tokarewicz,\* MD, FRCSC; Edwin S. Nowak,† BSc, PhD

## Abstract • Résumé

Alkali burns of the eye can result in permanent visual impairment and are therefore potentially devastating. Immediate diagnosis and treatment are essential to a good prognosis. The authors report the case of a 52-year-old woman who suffered alkali keratitis as the result of the activation of an automobile air bag. This type of injury will be seen more frequently as more cars are equipped with air bags and should be suspected in drivers and passengers involved in accidents in which air bags have been activated.

Les brûlures aux yeux causées par une substance alcaline peuvent entraîner une déficience visuelle permanente et peuvent donc être catastrophiques. Un diagnostic et un traitement immédiats sont essentiels à un bon pronostic. Les auteurs décrivent le cas d'une femme de 52 ans qui a été victime d'une kératite causée par une substance alcaline à la suite du déclenchement du coussin gonflable d'une automobile. Ce type de blessure sera constaté plus souvent, car les automobiles dotées de coussins gonflables sont de plus en plus nombreuses. Il faut donc soupçonner la présence de telles blessures chez les conducteurs et les passagers victimes d'accidents qui ont déclenché des coussins gonflables.

Alkali burns of the eye can result in permanent visual impairment and are therefore potentially devastating.<sup>1</sup> To increase the chance of a good prognosis it is vital to recognize such injuries quickly and begin treatment without delay.

In the last 3 years automobile air bags have been implicated in many ocular injuries, including corneal abrasion, hyphema, angle recession, lens subluxation, traumatic iritis, vitreous hemorrhage, retinal tearing, dialysis and detachment, intraretinal and subretinal hemorrhage, commotio retinae, macular hole and choroidal rupture.<sup>2-12</sup> To the best of our knowledge there have been two reported cases of alkali keratitis, both of which were mild and had a good outcome.<sup>11,12</sup> We describe a third case, which we believe to be the first reported in Canada. As installation of air bags in automobiles becomes more common this potentially severe injury will be encountered more frequently.

## CASE REPORT

A 52-year-old woman was driving a late-model, full-size North American automobile equipped with air bags on the driver's and passenger's sides. She was involved in

a head-on collision; both vehicles were moving at approximately 80 km/h. The driver of the other vehicle was killed instantly. Both air bags in the patient's car expanded immediately, and the patient's face struck the air bag on the driver's side. The patient was using her seatbelt and was not wearing eyeglasses or contact lenses. She suffered multiple orthopedic injuries (primarily involving the legs) as well as a large through-and-through laceration of the tongue and superficial lacerations of the neck. Examination of the patient in the emergency department 75 minutes later revealed that her left cornea was opaque and that she was unable to count fingers at close range with that eye. The pH of the inferior cul-de-sac of the left eye was measured with litmus paper and was found to be between 8.5 and 9.0, the normal range being 7.0 to 7.4. The eye was irrigated immediately with normal saline, and the pH decreased to 6.0.

The left cornea was still cloudy 5 hours later. The hospital's ophthalmology service was consulted, but in view of the patient's injuries, which required her to be kept supine and immobile, only a limited examination could be performed. The visual acuity was counting fingers in the right eye and hand motions in the left. The pupils appeared equal and reactive to light; the left pupil

From the \*Ivey Institute of Ophthalmology, Victoria Hospital, London, Ont., and the †Accident Research Team, Faculty of Engineering Science, University of Western Ontario, London, Ont.

Correspondence to: Dr. Robert B. Orton, Ivey Institute of Ophthalmology, Victoria Hospital, PO Box 5375, London ON N6A 4G5

was difficult to visualize because of diffuse corneal opacification. The conjunctiva was minimally injected in the left eye but was very chemotic, and there was diffuse corneal and conjunctival epithelial damage. The pH was between 8.5 and 9.0. A much smaller, localized area of corneal opacification and epithelial damage was present in the interpalpebral zone in the right eye.

The eyes were irrigated with normal saline (3 L into each eye for 90 minutes). The pH immediately thereafter and 30 minutes later was 7.2 in both eyes.

The patient was then given intensive topical treatment with cycloplegics, steroids, antibiotics, *N*-acetyl-L-cysteine, ascorbic acid and lubricants. Her right eye had returned to normal (with a corrected visual acuity of 20/20) by 4 days after the accident. With aggressive medical management as just described, her left eye slowly re-epithelialized over 5 weeks. A detailed examination of the posterior segment performed at 5 weeks revealed no damage. The final corrected visual acuity in the left eye was 20/30, although the eye remained dry and had mild adnexal scarring.

## COMMENTS

Alkali keratitis presumed to result from air-bag activation has been reported on two previous occasions.<sup>11,12</sup> The first case involved a 2-year-old boy who incurred burns in both eyes when he was thrown from the rear of the car to beneath the dashboard.<sup>11</sup> The visual acuity 1 month after the accident was 20/40 in the right eye and 20/30 in the left. In the second case a 46-year-old man was travelling at approximately 55 km/h when his car was struck obliquely from the rear. His face struck the driver's-side air bag when it inflated and he incurred a burn in one eye; the final visual acuity (in this eye) was 20/25+.<sup>12</sup> The authors of the second case report suggested that the testing of ocular pH should be standard practice when signs or symptoms of eye damage are detected after the activation of an automobile air bag.

Air bags are designed to inflate when there is a sudden longitudinal deceleration similar to that which would occur when a vehicle travelling at 13 to 26 km/h collides with a barrier.<sup>7,12</sup> Approximately 70 g of sodium azide is ignited, causing a 60-L air bag to inflate in about 0.01 of a second. This combustion creates a fine alkali aerosol containing sodium hydroxide and sodium carbonate that is at least partly released through the vents of the air bag into the passenger compartment of the automobile. The air bag does not have to rupture for this to occur. This alkali aerosol may have been the cause of the ocular burn in our patient. However, had it not been for the air bag and the seatbelt the patient would almost certainly have died as a result of the accident.

We report this case to emphasize that alkali keratitis is a vision-threatening injury that can result from air-bag activation; we had not been fully aware of this possibility. Such injuries will become more common as the use of air bags increases. An ocular alkali burn can easily be detected in the emergency department by testing the pH of the inferior cul-de-sac with litmus paper; if such a burn is found it should be treated like any other alkali burn. Management should include immediate copious irrigation of the eye with water or normal saline; this can be facilitated by the use of hand-held intravenous tubing, an irrigating eyelid speculum or a special scleral contact lens connected to intravenous tubing. In addition, the conjunctival fornices should be swabbed to ensure that no particulate matter that might continue to release alkali remains. The pH should be checked immediately after irrigation and, because it may continue to increase, 30 minutes later. Urgent ophthalmologic consultation is advised; subsequent treatment will depend on the severity of the injury.

## References

1. Wagoner M, Kenyon K: Chemical injuries. In Shingleton BR, Hersh PD, Kenyon KR (eds): *Eye Trauma*, Mosby Year Book, St. Louis, 1991: 80-89
2. Larkin GL: Airbag-mediated corneal injury. *Am J Emerg Med* 1991; 9: 444-446
3. Huelke DF, Moore JL, Ostrom M: Airbag injuries and occupant protection. *J Trauma* 1992; 33: 894-898
4. Mishler KE: Hyphema caused by airbag. *Arch Ophthalmol* 1991; 109: 1635
5. Scott IU, John CJ, Stark WJ: Airbag-associated ocular injury and periorbital fractures. *Arch Ophthalmol* 1993; 111: 25
6. Leshner MP, Durrie DS, Stiles MC: Corneal edema, hyphema and angle recession after air bag inflation. *Arch Ophthalmol* 1993; 111: 1320-1322
7. Han DP: Retinal detachment caused by air bag injury. *Arch Ophthalmol* 1993; 111: 1317-1318
8. Rosenblatt M, Freilich B, Kirsch D: Airbags: trade-offs. *N Engl J Med* 1991; 325: 1518-1519
9. Whitacre MM, Pilchard WA: Air bag injury producing retinal dialysis and detachment. *Arch Ophthalmol* 1993; 11: 1320
10. Rimmer S, Schuler JD: Severe ocular trauma from a driver's side air bag. *Arch Ophthalmol* 1991; 109: 774
11. Ingraham HJ, Perry HD, Donnenfeld LD: Air-bag keratitis. [letter] *N Engl J Med* 1991; 324: 1599-1600
12. Smally AJ, Binzer A, Dolin S et al: Alkaline chemical keratitis: eye injury from air bags. *Ann Emerg Med* 1992; 21: 1400-1402